MONTHLY NOTICES

OF THE

ROYAL ASTRONOMICAL SOCIETY.

VOL. XXII. *April* 11, 1862. No. 6.

Dr. LEE, President, in the Chair.

Rev. J. Morton, Clifton;
J. F. Beckett, Esq., R.N.;
Rev. E. K. Elliott, Broadwater; and
N. Martindale, Esq., Holmfield, near Liverpool,
were balloted for and duly elected Fellows of the Society.

On a Re-discovery of the missing Lunar Crater, Alhazen, situated on the western border of the Mare Crisium. By W. R. Birt, Esq.

The Rev. T. W. Webb, in his interesting catalogue of lunar objects, speaks thus of this crater:—

"On the western edge of the *Mare Crisium*, Schröter delineated a crater, called by him *Alhazen*, which he employed to measure the existing libration: he saw in it, after a time, unaccountable changes; and now it is said it cannot be found. Beer and Mädler think he confounded it with a crater lying further south; the question, however, which in the interim was debated between Kunowsky and Köhler, is not quite cleared up."

Having obtained a view, in January last, of *two* objects which appeared to me to have given rise to Schröter's remarks, I communicated my observations to Mr. Webb, and have lately received from that gentleman the following historical notices

of *Alhazen*, bearing especially on the variability of its aspect: —

"Schröter had watched and measured from it for years, and found it too varying in aspect to be accounted for by the varying angle of illumination. At first it was a depressed surface, surrounded by a ring, and distinguished from the neighbouring objects under all angles by its dark grey tint. Subsequently it often appeared, even in a 27-foot reflector (mirror about 20 inches), under favourable circumstances, as a bright longish flat mountain, though *more* frequently in its original grey aspect; occasionally it would be so indistinct, other objects being well defined, that he could not tell what to make of it. 1797, March 1, *Alhazen* being very near the limb (only 27″·27 from it), and therefore in a position to be very indistinct, especially as the terminator had advanced to the other side of the *Mare*, he saw it with a 13-foot reflector (mirror about 9 inches and power 180) more distinctly than ever, and in quite a new form, as a real, very deep, and bright crater, with an irregular ring scarcely united to the south, and open to the north, with a projection on the east side. Also there was a small shadow, as of a crater never seen before during the innumerable observations of ten years. Schröter thought *Alhazen*, under this aspect, appeared as deep as *Proclus*."

Mr. Webb enclosed a tracing, with this remark: — "I think you will consider it as affording an interesting comparison with your own observations. He has figured, you will see (as well as described), a little crater where you describe 'two (?).' The circumstance of his ranges uniting so closely to the south may be due to a different libration."

Kunowsky, in the *Astronomische Jahrbuch* for 1825, speaks of *Alhazen* as lost. In the *Jahrbuch* for 1826, Pastorff, writing January 20, 1823, says his son repeatedly found *Alhazen*. Pastorff also saw it (see p. 250 of the same *Jahrbuch*).

In the *Jahrbuch* for 1827 (p. 135), Harding is recorded as having seen *Alhazen* as Schröter had drawn it. Pastorff saw it in the same year, and in 1829.

The difference of aspect, as well as the occasional difficulty of finding this interesting spot, is highly curious. Schröter's earliest delineation gives it, as described, a shallow depression, *entirely* surrounded by a ring. My own observations, which now follow, may perhaps throw some light on these differences and difficulties. Two ranges of mountains, *one behind the other*, may easily be taken for a crater, and at a certain angle of illumination it may be exceedingly difficult to distinguish the difference. After a while the supposed crater entirely vanishes; libration alters the visual angle, and rotation the illuminating one, the observer being greatly puzzled as to what has become of his well-recognised crater.

1862, Jan. $3^{d}\ 4^{h}\ 45^{m}$ to $6^{h}\ 0^{m}$, Moon's age $3^{d}\cdot1$, the termina-

tor passing through the *Mare Crisium* a little west of *Picard*, the floors of *Cleomedes*, *Burckhardt*, *Geminus*, and *Bernouilli* being in deep shadow, the *Promontorium Agarum* was very distinct, and in fine relief, and the craters *Condorcet*, *Hansen*, and *Alhazen* of Beer and Mädler exceedingly well marked; the *Alhazen* of Schröter also very distinct, and *Eimmart* between it and *Cleomedes* well seen.

Schröter's *Alhazen*, at first sight, appears to have somewhat the appearance of a crater, the west edge being high, but the east much lower. Upon attentively considering it, I have some reason to think that it consists of *two* nearly parallel ranges of mountains just on the borders of the *Mare*, the eastern range forming a part of the actual border. The shadow of the western range is (under this illumination) terminated at a line west of the eastern range, the western slope of which is glowing in bright sunshine. The mountain south of *Alhazen*, also figured by Schröter, is exceedingly distinct, and stands on the border of the *Mare*.

From the circumstance of not finding a distinct crater in this part of the border of the *Mare Crisium* when the evening shadows set in and the terminator sweeps over the western border of the *Mare*, combined with the surface of the *Mare* running in amongst the mountains on the west of the *Mare*, I am the more inclined to consider the appearance of a crater to be produced when the shadow of the western range falls short of the eastern.

1862, Jan. 4^{d} 5^{h} 30^{m} to 7^{h} 16^{m}, Moon's age $4^{d}\cdot1$, terminator obliquely through *Atlas*. *Oersted*, *Cepheus*, *Franklin*, and *Berzelius*, with *Promontorium Archideum*, form a fine chain between *Atlas* and *Geminus*.

At times the definition has been very fine, and the real character of Schröter's *Alhazen* well seen; the southern termination of the two mountain-ranges was seen to be quite separate the one from the other, and the level surface passing between them. It is not surprising that the two combined should have been regarded as a crater, especially if viewed by a low power; for now, haze coming on, it is impossible to distinguish the two from a crater. In the earlier part of the evening the independence of the two ranges, especially on the south, was very apparent: the *shorter* shadow brought out very distinctly the *mountain* character, and the recess of the shadow of the eastern range revealed the existence of two (?) small craters lying at the foot of the eastern slope, upon the very border of the *Mare Crisium*. Beer and Mädler figure two mountain-ranges in the locality, but very unlike the mountain-ranges described above.

Note on a dark, circular Spot upon the Sun's Disk, with rapid motion, as observed by W. Lummis, Esq., of Manchester, 1862, March 20. By J. R. Hind, Esq.

In a letter addressed to me on the 20th of March, by W. Lummis, Esq., of the Manchester, Sheffield, and Lincolnshire Railway Company's Office at Manchester, it was stated that on the morning of the same day, while examining the Sun's disk with a telescope of about $2\frac{3}{4}$ inches aperture, he had remarked a small black spot more regular and better defined than usual. He watched it about 20 minutes, during which time it had moved rapidly, as shown in a diagram accompanying his letter, maintaining its *round* form : Mr. Lummis called a friend to see it, who remarked it as distinctly as himself.

On applying for further information with reference to his observation, Mr. Lummis wrote me, "As to the positions of the spot I regret that I cannot give them with much more precision than shown in the rough sketch sent to you, which was taken from one made at the time I witnessed the transit. I had no instrument but the telescope, and I measured with a small strip of card the distances of the spot from the Sun's edge. From the time when I first observed it, $8^h\ 28^m$ A.M., (Manchester time) to $8^h\ 50^m$, the spot had moved over about 12′ of arc, as nearly as I can judge by the eye, and its size or rather apparent diameter I should take to be about 7″. The telescope is $2\frac{3}{4}$ inches in aperture and magnifies 80 times. I had for several mornings been observing the Sun, which I noticed was particularly free from spots. Only one small one could be detected by me on the morning of the 20th, just below the spot marked A on the sketch.* I regret extremely having been compelled to leave before the object had completed its transit, as I should have wished to have witnessed its egress."

On carefully reading off from Mr. Lummis's sketch the differences of azimuth and altitude of the spot and Sun's centre, and converting them into differences of longitude and latitude, I find the following numbers,

G.M.T.	
March 19 $20^h\ 37^m$	Longitude of spot = Long. of ⊙ − 2′·4 Latitude of spot = + 3′·9
,, $20^h\ 59^m$	Longitude of spot = Long. of ⊙ − 7′·0 Latitude of spot = + 5′·5

It is evident, from the sketch, that Mr. Lummis's estimate of the arc passed over during the twenty-two minutes he watched the spot, is much too great. It would be nearer 6′ than 12′.

In a letter dated 2d May, addressed to the Editor, Mr. Lummis writes that the spot appeared quite circular, and perfectly and sharply defined, and that the dimensions stated (viz. 7″) may be regarded as a maximum measurement.

* The first position of the moving spot.

Considerations on the Solar Spots. By M. Eugene Jeanjaquet.

The author refers to his work, *Phénomènes Célestes résultant de la Transmission successive de la Lumière*, published in 1859, as containing the following evident proof that the solar spots, whatever their nature may be, are not the appearances (*les aperçus*) of an obscure nucleus, situate in the centre of the photosphere, and consequently that there is no reason for believing in the existence of such a nucleus. "Si le soleil," he said, "était composé tout à la fois d'une noyau solide et d'une triple enveloppe gazeuse concentrique à ce noyau, si mince que fût cette enveloppe elle n'en augmenterait pas moins l'astre de son épaisseur; il y aurait par conséquent sur tout le pourtour du disque une bande circulaire sur laquelle aucune tache ne pourrait se montrer; en d'autres termes, ce n'est qu'à une certaine distance, en dedans du disque, que des taches pourraient se laisser voir. Or, les taches commencent et finissent avec les bords mêmes du soleil; donc elles ne sont pas des ouvertures dans le sein de l'atmosphère vraie ou fausse de l'astre de jour."

And, after illustrating this proof by a figure, he proceeds as follows:—

"Mais les taches solaires commencent-elles et finissent-elles réellement sur les bords de l'astre radieux? Il semble, tant la chose est suffisamment établie, que je pourrais me dispenser de faire cette question. Il s'en faut de beaucoup cependant que je ne doive pas la soulever. Suivant quelques observateurs, l'enveloppe solaire, dans l'hypothèse du globe central obscur, est excessivement peu épaisse; elle n'aurait de profondeur, d'après M. Secchi, que dans la minime proportion de quatre millimètres sur un globe d'un mêtre de rayon.* Il est vrai de dire que M. Secchi, tout en faisant l'enveloppe solaire si mince, ne prétend pas imposer de tous points sa manière de voir. Il déclare lui-même que son opinion n'a rien d'absolu, puisqu'elle est le résultat d'une seule observation, et qu'il existe probablement des ouvertures plus profondes que celle qui lui a servi de mesure. Quoiqu'il en soit, l'enveloppe aurait dans tous les cas très-peu d'épaisseur. Or, une aussi mince enveloppe, si elle existe, réporterait naturellement les taches très-près des bords du soleil, si près même de ces bords que leur lieu d'apparition et de disparition ne pourrait souvent être constaté qu'avec la plus grande peine; partant, que l'on n'aurait absolument aucune assurance qu'un globe solide ne se trouvé pas en définitive au centre de l'astre du jour. La question de savoir si véritablement les taches naissent et s'effacent sur les bords du soleil est donc discutable, et elle mérite certainement d'être discutée.

* *Astronomische Nachrichten*, No. 1148, p. 307.

"Puis, il y a une autre question, se rattachant à l'existence des taches aux extrêmités du disque solaire, qui mérite aussi d'être étudiée. Des entailles ont été vues occasionnellement sur le limbe du soleil, et ces entailles n'ont pas tardé à être suivies de taches. Est-ce que de semblables faits n'impliquent pas nécessairement des ouvertures dans une enveloppe, et au fond de ces ouvertures le corps intérieur de l'astre radieux?

"Je m'empresse de le dire; en ce qui touche la mince enveloppe du soleil, assez d'apparitions et de disparitions de taches ont été constatées pour qu'il ne puisse pas y avoir de doute sur le lieu où ces apparitions et disparitions s'opèrent. Ceux qui, depuis Galilée jusqu'à nos jours, ont longuement et patiemment examiné le soleil pour déduire du mouvement de ses taches le temps de sa rotation, ne nous auraient point donné le temps de cette rotation s'ils n'avaient pas vu des taches naître et mourir aux bords mêmes de l'astre lumineux. On ne lit dans les écrits d'aucun observateur que les taches commencent et finissent en dedans du limbe solaire, tandis qu'il n'est pas un auteur un peu compétent qui n'enseigne qu'elles apparaissent et disparaissent sur les bords mêmes de l'astre. Toutes nos connaissances sur le mouvement des taches seraient vaines, si les instants d'apparition et de disparition de ces étranges figures, aux limites extrêmes du soleil, ne nous étaient pas parfaitement connus. Que de choses, en revanche, ne saurions-nous pas sur le prétendu globe obscur, sur sa grandeur, sa distance à l'astre de lumière, etc. etc., si toutes les taches commençaient et finissaient en dedans du disque, à une distance des bords régulièrement la même! Nous ne savons pas ces choses, du moins nous ne les savons pas comme nous devrions les savoir; les taches ne se lèvent ni ne se couchent donc point, pour ainsi parler, à l'intérieur du disque solaire. Ainsi, on peut-être parfaitement tranquille, les taches apparaissent bien au bord oriental du soleil, et elles disparaissent bien à son bord occidental; rien n'est plus certaine que ce fait-là.

"Au surplus, des taches naîtraient et mourraient régulièrement à une certaine distance en dedans du disque du soleil (ce que les observations n'indiquent point, mais que j'admets ici un instant par voie de supposition), des taches, dis-je, naîtraient et mourraient régulièrement en dedans du disque solaire, à une courte distance des bords, que même une semblable circonstance, à moins que les taches ne fussent grandes, fortes, bien distinctes, ne serait nullement conclusive de l'hypothèse du globe central obscur, puis qu'on pourrait toujours objecter que les taches disparaissent par l'effet de l'éloignement: ne sait-on pas combien les noyaux se rapetissent à mesure qu'ils s'éloignent du centre du soleil, combien ils grandissent au contraire à mesure qu'ils s'approchent de ce centre?

"J'arrive aux entailles qui se voient occasionnellement sur les bords du soleil et qui ne sont naturellement autre chose que de fort grandes taches, tout noyau sur le limbe solaire y pro-

duisant nécessairement une échancrure. Si ces entailles se montrent en noir, on comprend que mon opinion s'en trouve fortifiée; et c'est bien en noir qu'elles se montrent. Mais il paraît qu'il y a à cette règle des exceptions et qu'en de certaines occasions, excessivement rares d'ailleurs, des entailles ont été vues béantes; c'est du moins ce qui semble surtout ressortir d'une grande échancrure que M. Lawson a observée le 30 Juin, 1846, sur le bord oriental du soleil, échancrure à laquelle une tache noire n'aurait pas tardé de faire suite. Une entaille béante suivie immédiatement d'une tache! Une ouverture photosphérique avec un noyau à sa base! Quelle plus grande preuve pourrait-on donner de l'existence d'un globe central obscur! Heureusement que pour répondre à cette formidable objection, nous avons l'exemple de la lune dans les éclipses de soleil. La lune aussi lorsqu'elle échancre le soleil, fait sur lui une entaille libre, et ce n'est jamais que lorsqu'elle le recouvre en entier qu'elle se révèle en *noir:* pourquoi un noyau de tache, s'avançant sur l'astre de lumière, ne se conduirait-il pas, toutes proportions gardées, de la même façon que notre satellite?* Ainsi, bien loin qu'une entaille béante indique une ouverture sur le bord de l'astre, on peut dire qu'une semblable échancrure est une preuve de plus de l'existence des taches aux extrêmes limites du disque du soleil."

"*Neuchâtel* (*Suisse*), le 28–30 Mars 1862."

On the Transit of Mercury of 12 *Nov.* 1861, *observed at Hobart Town.* By Mr. Abbott.

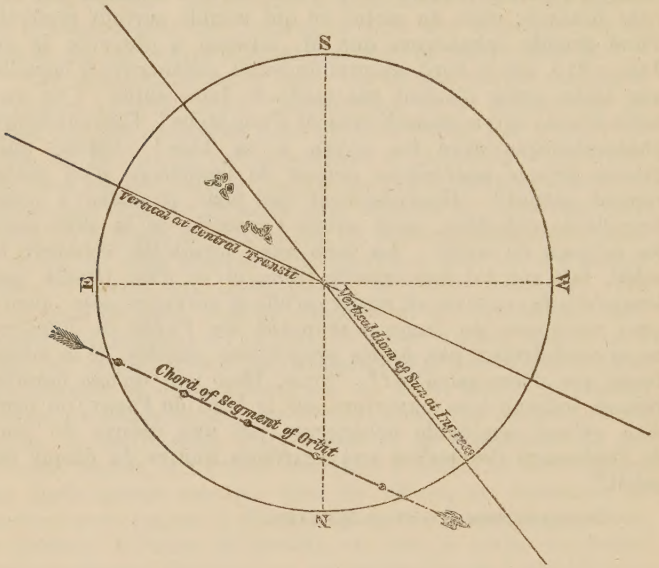
I transmit a diagram of the transit of *Mercury*, which occurred on the 12th of the present month. The time of ingress stated may not be quite as correct as I could have wished, from the following circumstances,—

To make sure of true time I had taken a transit at noon on the same day; on that point, therefore, I considered myself well prepared for the occasion.

A short time before the immersion, I had erected a 5-foot telescope on one of Varley's stands, and at the very point of the planet's contact, one of the bands gave way, which caused at that critical moment a slight confusion, until I could get the telescope tube remounted on a fresh stand; notwithstanding this accident I consider the time given a close approximation.

* "On n'a pas suffisamment fait attention, à mon avis, à tout ce qu'il y a de remarquable dans cette manière d'agir de la lune, parfaitement *invisible* tant qu'il reste une parcelle de lumière solaire, et, une fois le dernier filet de lumière supprimé, se montrant immédiatement en *noir*."

The afternoon on the whole was favourable, and had it not been for Mount Wellington (4240 feet high) blocking out our western horizon, the whole transit might have been seen, from ingress to egress.



Observed time of ingress for Hobart Town Mean Time.

	h	m	s	
Exterior contact.....	3	6	16	P.M.
Centre	3	8	25	,,
Interior contact	3	9	36	,,

Hobart Town, Tasmania, Nov. 25, 1861.

Results of Meridional Observations of Small Planets; Occultations of a Star by the Moon; and Phenomena of Jupiter's Satellites; observed at the Royal Observatory, Greenwich, during the month of March, 1862.

(*Communicated by the Astronomer Royal.*)

Flora (8).

Mean Solar Time of Observation.		R.A. from Observation.	N.P.D. from Observation.
	h m s	h m s	° ′ ″
1862, Mar. 25	13 57 22·8	14 10 25·49	93 17 42·46

Metis (9).

Mean Solar Time of Observation.		R.A. from Observation.	N.P.D. from Observation.
	h m s	h m s	° ′ ″
1862, Mar. 4	9 40 33·9	8 30 6·85	62 15 40·00
8	9 23 47·4	8 29 3·77	62 20 57·70
10	9 15 37·0	8 28 45·12	62 24 38·50
12	9 7 34·6	8 28 34·57	62 28 50·88

Eunomia (15).

Mean Solar Time of Observation.		R.A. from Observation.	N.P.D. from Observation.
	h m s	h m s	° ′ ″
1862, Mar. 4	9 16 54·2	8 6 23·29	76 1 7·76
12	8 43 34·1	8 4 30·11	76 6 16·08

Psyche (16).

Mean Solar Time of Observation.		R.A. from Observation.	N.P.D. from Observation.
	h m s	h m s	° ′ ″
1862, Mar. 3	11 22 0·5	10 7 53·58	78 12 20·13
4	11 17 19·9	10 7 8·72	78 7 30·69

Thalia (23).

Mean Solar Time of Observation.		R.A. from Observation.	N.P.D. from Observation.
	h m s	h m s	° ′ ″
1862, Mar. 3	11 50 45·8	10 36 43·55	60 38 39·90
4	11 45 56·7	10 35 50·27	60 36 48·56

Amphitrite (29).

Mean Solar Time of Observation.		R.A. from Observation.	N.P.D. from Observation.
	h m s	h m s	° ′ ″
1862, Mar. 3	13 19 15·0	12 5 27·33	90 15 3·66
25	11 32 37·2	11 45 16·15	88 58 46·20

All the observations of N.P.D. have been corrected for Refraction and Parallax.

March 9. The disappearance of 6 *Geminorum* at the Moon's dark limb was observed by Mr. Criswick to take place at $7^h\ 1^m\ 40^s{\cdot}6$ mean solar time.

Phenomena of Jupiter's Satellites.

Day of Observation. 1862.	Satellite.	Phenomenon.	Mean Solar Time. h m s	Observer.
Mar. 4	III	Ecl. disapp.	14 38 34·5	T. C.
25	I	Egress, first cont.	8 38 41·9	C.
25	I	,, bisection	8 40 11·6	C.
25	I	,, last cont.	8 42 11·3	C.

The initials C. and T. C., are those of Mr. Criswick and Mr. Chappell.

Observations of Encke's Comet, taken with the Equatoreal of the Liverpool Observatory. By J. Hartnup, Esq.

Day.	G.M.T. h m s	Comet's R.A. h m s	Comet's N.P.D. ° ′ ″	Stars of Comparison.
1861, Dec. 1	7 20 17·0	22 25 2·79	83 21 1·3	ζ Pegasi.
5	7 4 3·9	22 22 32·99	83 57 41·8	,,
21	7 11 28·5	22 18 3·45	85 49 6·7	η Aquarii.
25	6 9 34·7	22 17 47·26	86 11 47·3	,,
28	6 4 37·2	22 17 38·68	86 28 50·7	,,
1862, Jan. 22	6 8 56·6	21 57 27·29	92 32 37·2	δ and η Aquarii.
25	6 8 5·2	21 47 20·09	94 45 10·4	α Aquarii.

The observations are corrected for Refraction and Parallax.

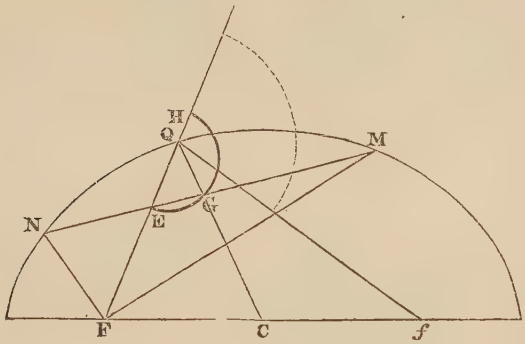
The places of the stars of comparison were taken from the *Nautical Almanac*.

On Lambert's Theorem for Elliptic Motion. By A. Cayley, Esq.

The theorem referred to is that which gives the time of description of an elliptic arc in terms of the radius vectors and the chord. The demonstration given by the author in his "Insigniores Orbitæ Cometarum Proprietates," Augs. 1761, depends upon a series of geometrical propositions of great elegance, which may be thus stated,

Let F Q be a line given in magnitude and position, E a given point on this line, Q f a line given in magnitude only, the position thereof being determined by assigning a value to

its variable inclination to the line F Q. With F, *f*, as foci describe an ellipse passing through the point Q (the axis major = F Q + Q*f*, is of course a constant magnitude). Take C,



the centre of the ellipse, and join C Q; through E draw a chord, M E N, conjugate to the diameter C Q, and meeting it in G. Then treating the inclination as variable,

1°. The locus of G is a circle passing through E, and having its centre on the line F Q.

2°. The semichord G M or G N, and the sum F M + F N of the radius vectors are respectively constant.

3°. The elliptic area N F M, divided by the square root of the latus rectum, is a constant.

It may also be mentioned, that taking 2θ to represent the external inclination (supplement of the angle F Q*f*), and if, moreover, a is the semiaxis major, e the excentricity, and u, u' the excentric anomalies of the points M, N, then the square root of the latus rectum, or say $\sqrt{1-e^2}$, $\propto \sin\theta$, and moreover E M, E N, F M, F N, $e\cos u$, $e\cos u'$, $e\sin u$, $e\sin u'$, consist each of them of a constant part, *plus* a part which $\propto \cos\theta$; these expressions give as above G M = G N = $\frac{1}{2}$ (E M + E N) = constant, F M + F N = constant; and they give moreover $e\cos u + e\cos u' =$ constant; $e\sin u - e\sin u' =$ constant; $u - u' =$ const. The expression for the area is $\frac{1}{2}a^2\sqrt{1-e^2}\{u-u'-(e\sin u - e\sin u')\}$, and consequently the area divided by $\sqrt{1-e^2}$ is a constant; that is, the area is, as stated above, proportional to the square root of the latus rectum.

Hence, assuming the dynamical theorem that for a given central force at F, varying inversely as the square of the distance, the time of describing the elliptic arc is proportional to the area divided by the square root of the latus rectum, the time of describing the elliptic arc is constant. But in the extreme case, where the point *f* lies in the line F Q produced in

the direction from F to Q, the ellipse reduces itself to a finite right line, length F Q + Q f, which is considered to be described by a body falling from the extremity with an initial velocity zero; and the arc M N is a portion thereof given in magnitude, and having for its centre the point H (where E H is the diameter of the before-mentioned circle, the locus of G). Hence the time of describing the elliptic arc is equal to the time of describing, under the action of the same central force, a given right line, and as such it is at once obtainable in the form

$$\frac{a^{\frac{3}{2}}}{\sqrt{\mu}} (\phi - \phi' - (\sin\phi - \sin\phi'))$$

where ϕ, ϕ' are functions of the major axis F Q + Q f, and of F M, F N, or, what is the same thing, of F Q + Q f, and of the chord M N and sum of the radius vectors F M, F N. The preceding is the geometrical mode of getting out the result, without the assistance of any expression for the elliptic area, and latus rectum, and assuming only that we know the formula for rectilineal motion; but, if the expressions for the elliptic area and latus rectum are obtained, then the expression for the time is known, and the problem is solved, without the necessity of passing from the ellipse to the right line.

Writing F Q = ϱ, Q F = σ, and as before the exterior angle of inclination = 2 θ, the actual expressions for the various lines of the figure are easily found to be

$$\frac{1}{2}(\varrho + \sigma) \quad , \quad = a$$

$$\mathrm{C\,F} = \mathrm{C}f = \frac{1}{2}\sqrt{\varrho^2 + \sigma^2 + 2\varrho\sigma\cos 2\theta}, \quad = a$$

$$\mathrm{C\,Q} = \frac{1}{2}\sqrt{\varrho^2 + \sigma^2 - 2\varrho\sigma\cos 2\theta}, \quad (= a'$$

$$\mathrm{C\,R} = \sqrt{\varrho\sigma} \quad , \quad (= b'$$

where C R (not shown in the figure) denotes the semi-diameter conjugate to C Q.

$$1 - e^2 = \frac{4\varrho\sigma}{(\varrho + \sigma)^2} \sin^2\theta$$

$$\cos \mathrm{F} = \frac{\varrho + \sigma\cos 2\theta}{2ae}, \quad \cos \mathrm{Q} = \frac{\varrho - \sigma\cos 2\theta}{2a'},$$

$$\sin \mathrm{F} = \frac{\sigma \sin 2\theta}{2ae}, \quad \sin \mathrm{Q} = \frac{\sigma \sin 2\theta}{2a'}, \quad \sin \mathrm{C} = \frac{\varrho\sigma \sin 2\theta}{4a'ae},$$

where F, C, Q, denote the angles of the triangle FCQ, respectively,

$$EG = \frac{2k\sigma}{\varrho+\sigma}\cos\theta, \quad \text{and } \therefore EH = \frac{2k\sigma}{\varrho+\sigma},$$

$$QG = \frac{k}{\varrho+\sigma}2a',$$

and, if for shortness $\Delta = \sqrt{k\varrho\sigma(\varrho+\sigma-k)}$, then

$$(EM, EN) = \frac{2}{\varrho+\sigma}(\Delta \pm k\sigma\cos\theta),$$

$$(FM, FN) = \frac{1}{\varrho+\sigma}\{\varrho(\sigma+\varrho)+k(\sigma-\varrho) \pm 2\Delta\cos\theta\},$$

so that

$$GM = GN = \frac{1}{2}(EM + EN) = \frac{2\Delta}{\varrho+\sigma},$$

$$\frac{1}{2}(FM + FN) = \frac{1}{\varrho+\sigma}\{\varrho(\sigma+\varrho)+k(\sigma-\varrho)\},$$

and moreover

$$(e\cos u, e\cos u') = \frac{1}{(\varrho+\sigma)^2}\{(\sigma-\varrho)(\varrho+\sigma-2k) \mp 4\Delta\cos\theta\},$$

$$(e\sin u, e\sin u') = \frac{1}{(\varrho+\sigma)^2}\left\{\pm\frac{2(\sigma-\varrho)\Delta}{\sqrt{\varrho\sigma}} + 2(\varrho+\sigma-2k)\sqrt{\varrho\sigma}\cos\theta\right\},$$

so that

$$e\cos u + e\cos u' = \frac{2}{(\varrho+\sigma)^2}(\varrho+\sigma-2k),$$

$$e\sin u - e\sin u' = \frac{4}{(\varrho+\sigma)^2}\frac{(\sigma-\varrho)\Delta}{\sqrt{\varrho\sigma}},$$

$$u - u' = 2\tan^{-1}\frac{2\Delta}{\sqrt{\varrho\sigma}(\varrho+\sigma-2k)} = \sin^{-1}\frac{4\Delta(\varrho+\sigma-2k)}{(\varrho+\sigma)^2\sqrt{\varrho\sigma}},$$

$$u - u' - (e\sin u - e\sin u') = \sin^{-1}\frac{4(\varrho+\sigma-2k)\Delta}{(\varrho+\sigma)^2\sqrt{\varrho\sigma}} - \frac{4(\sigma-\varrho)\Delta}{(\varrho+\sigma)^2\sqrt{\varrho\sigma}},$$

which is

$$= \phi - \phi' - (\sin\phi - \sin\phi'),$$

if

$$1-\cos\varphi = \frac{1}{2a}(FM+FM+MN) = \frac{2}{(\varrho+\sigma)^2}\{\varrho(\sigma+\varrho)+k(\sigma-\varrho)+2\Lambda\},$$

$$1-\cos\varphi' = \frac{1}{2a}(FM+FN-MN) = \frac{2}{(\varrho+\sigma)^2}\{\varrho(\sigma+\varrho)+k(\sigma-\varrho)-2\Lambda\}.$$

In fact we then have also

$$1+\cos\varphi = \frac{2}{(\varrho+\sigma)^2}\{\sigma(\sigma+\varrho)-k(\sigma-\varrho)-2\Lambda\},$$

$$1+\cos\varphi' = \frac{2}{(\varrho+\sigma)^2}\{\sigma(\sigma+\varrho)-k(\sigma-\varrho)+2\Lambda\},$$

and thence

$$\sin\tfrac{1}{2}\varphi = \frac{1}{\varrho+\sigma}\left(\sqrt{\varrho(\varrho+\sigma-k)}+\sqrt{k\sigma}\right),\quad \sin\tfrac{1}{2}\varphi' = \left(\sqrt{\varrho(\varrho+\sigma-k)}-\sqrt{k\sigma}\right),$$

$$\cos\tfrac{1}{2}\varphi = \frac{1}{\varrho+\sigma}\left(\sqrt{\sigma(\varrho+\sigma-k)}-\sqrt{k\varrho}\right),\quad \cos\tfrac{1}{2}\varphi' = \left(\sqrt{\sigma(\varrho+\sigma-k)}+\sqrt{k\varrho}\right),$$

whence

$$\sin\varphi = \frac{2}{(\varrho+\sigma)^2}\left\{\sqrt{\varrho\sigma}\,(\varrho+\sigma-2k)+\frac{(\sigma-\varrho)\sqrt{\Lambda}}{\sqrt{\varrho\sigma}}\right\},$$

$$\text{in}\,\varphi' = \frac{2}{(\varrho+\sigma)^2}\left\{\sqrt{\varrho\sigma}\,(\varrho+\sigma-2k)-\frac{(\sigma-\varrho)\sqrt{\Lambda}}{\sqrt{\varrho\sigma}}\right\},$$

$$\text{and}\ \therefore\quad \sin\varphi-\sin\varphi' = \frac{4(\sigma-\varrho)\sqrt{\Lambda}}{(\varrho+\sigma)^2\sqrt{\varrho\sigma}},$$

$$\sin\tfrac{1}{2}(\varphi-\varphi') = \frac{2k\Lambda}{(\varrho+\sigma)\sqrt{\varrho\sigma}},\quad \cos\tfrac{1}{2}(\varphi-\varphi') = \frac{\varrho+\sigma-2k}{\varrho+\sigma},$$

$$\text{and}\ \therefore\qquad \sin(\varphi-\varphi') = \frac{4(\varrho+\sigma-2k)\Lambda}{(\varrho+\sigma)^2\sqrt{\varrho\sigma}},$$

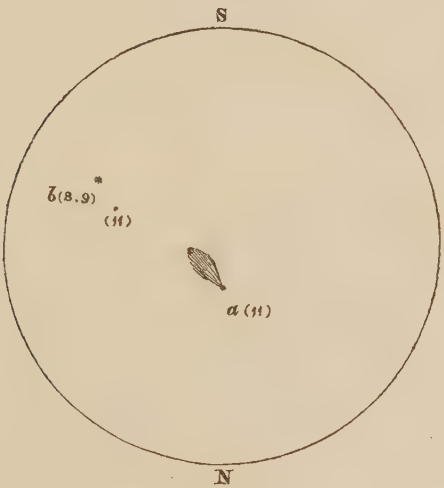
which verifies the formula.

On the missing Nebula in Taurus, on Comet II. 1861, *and on Mountain Attractions.* By M. O. Struve.

(*Communicated by the Astronomer Royal.*)

In the month of December we were informed by letters of Prof. d'Arrest's important observation, that the Nebula dis-

covered by Mr. Hind in the constellation of *Taurus* had disappeared. In the first favourable night, 1861, Dec. 29, we directed our large refractor upon the object, and in the first moment thought that its faintness exceeded even the power of our instrument; but, after some minutes, when the eyes had sufficiently adapted themselves to the darkness, we distinctly recognised some traces of nebulosity to the south of a star of 11th magnitude. Mr. Winnecke, whose assistance I had asked on this occasion, agreed with me entirely about the position of this nebulosity. The line joining it with the star of 11th magnitude made an angle of 15° f.f. with the line drawn from that star to another star of 11th magnitude, visible in the same field at a distance of 4′ south preceding. The distances of the brightest part of the Nebula from the first-mentioned star was estimated by me = 0·22, by Dr. Winnecke = 0·15 of the distance of the two stars, or about 50″. Since then we had for nearly three months' very unfavourable weather, and it was only in the night of March 22 that I thought there was a good opportunity for inspecting again that object. My expectation was not deceived. On the first glimpse the Nebula appeared considerably brighter than it did in December, so that it even bore a feeble illumination of the wires. On measuring the direction from the star *a* (see accompanying sketch), I found it 213°·2, while that of the star *b*, mag. 8.9, was 223°·6.



As the other small star which had served for comparison on Dec. 29, has nearly the same direction as *b*, this observation

confirms perfectly the estimation made on that former occasion. On March 22 I thought I could trace the nebulosity from the star *a* as far as one-third of the distance from *a* to *b*, or about 1′·7; but it was broader and more conspicuous nearer to *a*. There again it had the appearance as if on its extreme southern end there was a point of more concentrated light, which made the impression of being another extremely faint star, between which and the star *a* the Nebula extended the whole length. The sketch will give a general idea of what I saw. Also on this evening my observation was controlled by the sharp eye of Dr. Winnecké.

The facility with which I saw the Nebula in March, compared with the difficulty of the first observation, made upon me the impression as if in the interval the brightness of the Nebula had considerably increased; but this impression is probably in a great part due to the extraordinary transparency of the atmosphere we enjoyed in the month of March.

It will be remembered by the readers of the *Monthly Notices*, that my observations made in 1857 on the great Nebula of *Orion* had left with me the impression as if certain parts of its central region was subject to rapid changes of light. An extensive memoir containing the full account of my observations on this subject is nearly ready for distribution. It will be seen then that all the later observations have confirmed the first impression. The analogy between these observations and the recent discovery of Prof. d'Arrest is conspicuous; but a direct confirmation of my observation by an experienced observer established in a more southern position, and provided with sufficient optical means, is nevertheless very desirable. In this respect I hope Mr. Lassell's new expedition to Malta will afford results of a decisive character.

The extraordinary transparency of the atmosphere during the month of March afforded me the opportunity of making a series of observations of the great Comet of last year (II.1861), which, I trust, will offer a good normal position for this epoch. These observations bear the date of March 20, 21, 22, 25, and 28; the first observation was made in my absence by Dr. Winnecke; the others by me.

In the present month I have got until now only one determination on April 16, but I hope to get some more observations before the moon returns. The next month the midnight twilight will be too bright in our northern latitude to allow any observation of such a faint object; but in southern climates it might be yet observed some weeks more. With this view I subjoin here an Ephemeris computed by Mr. Liasser from ten to ten days, for the months of May to August, which, in the hands of Mr. Lassell or Mr. Bond, might prove useful:—

0h Berlin M.T.	Comet's R.A. h m	Comet's Decl. ° ′	Log r.	Log Δ.
April 30	22 34·1	76 51·1	0·648	0·673
May 10	22 55·2	79 7·3	·657	·684
20	23 17·9	81 18·4	·667	·694
30	23 43·8	83 24·0	·676	·704
June 9	0 16·5	85 23·1	·685	·713
19	1 8·9	87 13·6	·694	·722
29	3 32·8	88 43·8	·702	·730
July 9	9 10·3	88 36·8	·710	·737
19	11 9·3	87 15·8	·718	·743
29	11 57·9	85 50·9	·726	·749
Aug. 8	12 29·6	84 21·8	·734	·754
18	12 56·1	83 9·0	0·741	0·758

This Ephemeris shows that about July 1 the Comet will approach the north pole within a degree, a circumstance that, it appears, will complicate a little the reduction of the observations, if such should succeed about that time.

In the month of August the nights will be here again sufficiently dark to admit a look-out for the Comet, though the hope of seeing it distinctly at that advanced period is rather small. At present the distance of the Comet from the Sun and Earth is about 4·5 (the same as the large Comet of 1811 had when it was rediscovered by Wisniewsky, in the summer of 1812); but in August it will be about 5·6. Hence it follows that, taking $\frac{1}{r^2\Delta^2}$ for the coefficient of its light, this will be about 2·2 times less than it is now. On the other hand there is a strong suspicion, as already Prof. Schönfeld has pointed out, that the intensity of light of this Comet is subject to considerable variability, and this circumstance might, perhaps, favour a rediscovery. This suspicion has now some confirmation by my last observation. In one night it hardly bore any illumination of the field, while in other nights it could be distinctly seen even when the bright wire crossed it. But even in these nights I preferred using the method of celestial triangulation which rendered me such good service at the first appearance of Faye's Comet. On April 16 the diameter of the Comet was estimated about 40″. Its light is, even in its present faint state, not quite uniform, but shows distinctly traces of concentration.

Mr. Seeling's last elements of the Comet's orbit in No. 1347 of the *Astronomische Nachrichten*, which have served also for Mr. Liasser's Ephemeris, appears to be already very exact. A preliminary reduction of some observations has given the following differences:—

	C. − O. In R.A.	In Decl.
	s	′
March 20	−6·6	+0·1
,, 21	−5·0	0·0
,, 22	−7·6	+0·4

Hence we must conclude that also the period of 419·5 years, assigned to this Comet by Mr. Seeling, is very nearly exact; but, of course, the last observations, and yet more those that might be made in the next months, will very efficaciously contribute to inclose the uncertainty of the period into narrower limits. This expectation will for itself be a sufficient stimulus for astronomers to spend some trouble on a most prolonged observation. But I think the interest attached to this Comet is yet considerably increased by the consideration that the observations made about the time of its greatest proximity to the Earth, if rigorously reduced, might well serve to deduce at least a confirmation, if not a possible correction, of the Sun's parallax. With this view a strict and critical examination of all existing observations and a most uniform and exact determination of all the comparison-stars would be a necessary condition of success. In the last part of the work the Observatory of Pulkowa will be glad to co-operate if there is only some prospect that any astronomers will undertake the laborious task of working out the results systematically.

Three weeks ago I received interesting news from General Chodzko, the Surveyor-general of our Caucasian provinces. This distinguished officer had been engaged last year with a junction of the triangles measured under his direction to the south of the Caucasus with the geodetic operation in the southern part of European Russia. The chain of triangles measured for this purpose crossed the Caucasian mountains almost at right angles, and I suggested to him the idea of using this favourable opportunity for collecting new and exact data concerning the attraction of large mountain masses. Accordingly General Chodzko selected six stations, situated on both sides of the mountain chain, upon which exact determinations of latitude were to be made. These stations were,

1. Tiflis, about 70 miles south of the central line of mountains.
2. Douchet, ,, 35 ,, ,,
3. Kobi, very nearly on the central line.
4. Wladikawkas, about 35 miles north of the central line of mountains.
5. Alexandrowskaja, ,, 55 ,, ,, ,,
6. Mosdok, ,, 70 ,, ,, ,,

On these stations the observations for latitude were executed by Capt. Oblomievsky, the designated Director of the

Observatory of Tiflis, which next year will begin its astronomical activity.

These observations were not yet entirely reduced when General Chodzko wrote me, and it will be particularly regretted that the results for the central station Kobi are not yet at hand. For the other stations General Chodzko gives the following results, which will be exact within a second. Supposing the latitude of Tiflis to be not affected by local attraction, and designing by φ the latitude as determined by direct astronomical observations on each station, and by φ' the latitude of the same station when deduced geodetically from that of Tiflis, with Bessel's elements of the Earth's figure, we have

For Douchet $\varphi' - \varphi =$	$+25''.1$
Wladikawkas	$-28''.6$
Alexandrowskaja	$-12''.0$
Mosdok	$-5''.6$

Whoever knows a little the geography of the country will agree that it is much more probable that Mosdok is less affected by local attraction than Tiflis. Therefore, attributing the whole amount of $\varphi' - \varphi$, as found for Mosdok, to the effect of local attraction on the direction of the plumb-line at Tiflis, we shall have

For Tiflis $\varphi' - \varphi =$	$+5''.6$
Douchet	$+30''.7$
Wladikawkas	$-23''.0$
Alexandrowskaja	$-6''.4$

The latitudes of Douchet and Wladikawkas being respectively $42^\circ\ 5'$ and $43^\circ\ 1'$, we have here as the effect of mountain attraction, on an arc of only $56'$, a difference between the geodetic and astronomical arc of not less than $53''.7$; and the diminution of the quantity for Tiflis and Alexandrowskaja shows that the effect, as it ought to be, is there less approximately in proportion of the square of the distance from the principal chain of mountains. How far those differences answer the real attraction of the mountain masses will be the object of future inquiries, but even now it might be presumed that the result for the Caucasus will stand in some degree at variance with that obtained by the Indian triangulation for the Himalaya; so that the ingenious hypothetical explanation given by Mr. Airy for the apparent defect of attraction in those mountains will hardly meet with a satisfactory confirmation in the special case of the Caucasus. I have no doubt General Chodzko will continue these interesting researches with all the power he can command, and thereby furnish most precious results both for

geodesy and geology. Similar operations will be conducted by Prof. Schweizer in the neighbourhood of Moskwa (? Ed.), where it has been established by his preliminary researches that on an arc of 16′ the geodetic differences of latitude are greater by 18″ than the astronomical, and that these differences follow such a law as indicates a comparative defect of attracting matter, probably at some distance below the Earth's surface. Mr. Schweizer's preliminary researches will be published in a very short time.

Pulkowa, April 19th, 1862.

M. Struve has finally retired from the Presidency of the Observatory of Pulkowa; and it will be satisfactory to the Society to learn that M. Otto Struve has been officially appointed as his successor.

Letter from Sir John Herschel to Mr. Hind on the Disappearance of a Nebula in Coma Berenices.

(*Communicated by permission of Sir John Herschel.*)

I have met with another instance of the disappearance of a well-authenticated Nebula, which I think will interest you.

In M. d'Arrest's *Resultate aus Beobachtungen der Nebelflecken und Sternhaufen — Erste Reihe*, communicated to the *Royal Saxon Society of Sciences*, and printed in their *Transactions*, occur observations of two Nebulæ which M. d'Arrest considers as new, and sets down as "*novæ*," their places for 1850 being respectively

$$\left.\begin{array}{l} 185^\circ\,33'\,21''{\cdot}5 = 12^h\,22^m\,13^s{\cdot}4 \text{ R.A.} \\ 75^\circ\,44'\,32''{\cdot}5 \text{ N.P.D.} \end{array}\right\} \text{(A)}$$

and

$$\left.\begin{array}{l} 185^\circ\,40'\,16'' \;\; = 12^h\,22^m\,41^s{\cdot}0 \text{ R.A.} \\ 75^\circ\,32'\,2''{\cdot}0 \text{ N.P.D.} \end{array}\right\} \text{(B)}$$

(A)'s place is determined by two well-agreeing observations, and it is described as being bright, a 1st-class Nebula, round, 50″ in diameter, brighter in the middle to a star 10 mag.

(B)'s place by a single observation — very bright, 1st class, 50″ in diameter, round, brighter in the middle; a star 11 mag.

precedes $24^s{\cdot}6$ nearly in the parallel; the place not very exact, but the nebula *frequently seen since in that place.*

No mention is made of any companion-nebula in the same field of view; and M. d'Arrest is so good an observer that any such, of equal or nearly equal brightness, would assuredly, on all these several occasions, not have escaped him.

Both M. d'Arrest's Nebulæ, *and one more*, of an order o brightness little inferior to the latter (B), occur in Sir W. Herschel's catalogues, (A) being identified with H. II. 114, and (B) with one of the two, H. II. 115 and II. 116.

The place of H. II. 114 for 1850 is settled by two observations in sweeps 187 and 199, made on April 8th and 17th, 1784. In the former it is stated to follow 6 *Comæ* $13^m{\cdot}9 = 13^m\ 54^s$ in time, and to be $1^\circ\ 30'$ south of that star; in the latter to precede 34 *Virginis* $16^m{\cdot}9 = 16^m\ 54^s$ in time, and to be $1^\circ\ 28'$ north of it. These give respectively, for its place for 1850,

	h m s	° ′ ″
{	12 22 16·9	75 45 33
{	12 22 46·5	75 45 16
Mean	12 22 31·7 R.A.	75 45 34 N.P.D.

Of the identity of this with (A) there can, therefore, be no doubt.

Of H. II. 115 and 116 there occur also two observations in sweeps 187 and 691, made on the 8th of April, 1784, and 14th of January, 1787. In the former they are described thus:—"Two resolvable Nebulæ; they follow the 6th *Comæ* 14^m in time, and are $1^\circ\ 17'$ more south." In the latter they are described separately: the preceding as "very bright, considerably large, follows 6 *Comæ* $13^m\ 50^s$, south of it $1^\circ\ 19'$;" the following as "pretty bright, pretty large, follows 6 *Comæ* $14^m\ 5^s$, south of it $1^\circ\ 22'$."

It is certain therefore that both these Nebulæ were seen in the same field of view (for, when so paired together, such was invariably Sir W. Herschel's practice) on two occasions three years apart, so that neither was a comet; and by the second observation their respective situation was

$$\Delta\ \text{R.A.} = +\ 15^s, \qquad \Delta\ \text{N.P.D.} = +\ 3';$$

so that, supposing the place assigned in the first observation to refer to the middle point between them, we have their places,—

By observation 1st,

		h m s		° ′ ″
II. 115	R.A.	12 22 15·4	N.P.D.	75 30 33
II. 116	,,	12 22 30·4	,,	75 33 33

and by observation 2d,

		h	m	s		°	′	″
II. 115	R.A.	12	22	12·9	N.P.D.	75	34	53
II. 116	,,	12	22	27·9	,,	75	37	53

and taking the means,

II. 115	R.A.	12	22	14·1	N.P.D.	75	32	43
II. 116	,,	12	22	29·1	,,	75	35	43

The middle point between which differs from the place of (B) by only $19^{s}\cdot4$ in R.A. and $2'\,11''$ in P.D.; so that it is very certain that, had both the objects remained in their places, they must have been in the field of view of a telescope directed on (B).

M. d'Arrest's telescope has amply sufficient power to have shown the missing Nebula (the fainter of the two in all probability, or H. II. 116), which had sufficient illumination to be characterised as "resolvable," and as "pretty bright," or a full second-class Nebula.

Most unfortunately I find no observations of either of these Nebulæ in my reviews of the Nebulæ. They occur in a very rich region of the heavens; but by taking 6 *Comæ* as a guide, there can be no difficulty in setting a telescope upon the place; and I strongly recommend the point for re-examination.

Collingwood, April 4th, 1862.

Opposition of Mars, 1862. By Lieut. J. M. Gilliss, Director of the U.S. Naval Observatory, Washington.

The co-operation of astronomers is invited in a series of observations upon the planet *Mars*, near the opposition of the present year. Differential measures with the stars designated in the accompanying Ephemeris, will be made at the U. S. Naval Observatory, from 27th August to 7th November, 1862. They will be commenced at one hour before the transit of the planet over the meridian of Washington, and be continued during two hours, the measures being repeated as frequently and as rapidly as is consistent with the utmost care. The comparisons will be confined exclusively to the star selected for the night, and it will be referred to the north and south limbs of the planet at alternate measures, the time at which the planet's limb is observed being noted to the nearest tenth of a second. Both objects will also be observed with the meridian instruments, and their difference of declination will be measured with the micrometer-screw of the circle-telescope.

Astronomers who make these observations are most respectfully requested to forward a copy of them to this establishment as soon thereafter as is practicable, and to transmit, at the same time, a statement respecting the instruments used, together with any information which may influence a discussion of the results.

In preparing the Ephemeris, whenever suitable ones could be obtained, stars were selected from published catalogues, the criterion of availability being a difference of declination not to exceed 4′. For September 17th, it was necessary to take a more distant star. The places of those to which numbers only are given (1 to 11 inclusive) were derived from special observations made with the Washington Equatoreal. To facilitate recognition of the comparison-star selected for each night, all the stars contained in accessible Catalogues and Star-charts which lie near the path of the planet have been inserted on a map accompanying the Ephemeris.

A copy of this last, with the map, will be sent to every Observatory by mail. As some of the copies may not reach their destination, extra numbers will be forwarded to the Secretary, Royal Astronomical Society, London, and to Dr. C. A. F. Peters, at Altona, either of whom will furnish them on application.

Ephemeris of Stars to be observed with Mars near the Opposition of the Planet, 1862.

Date. 1862.	Object.	Mag.	α. h m s	δ. ° ′ ″
Aug. 27	Mars		1 17 30	+3 5 43
	Weisse I. 335	9	20 27	9 43
28	Mars		1 17 45	3 6 48
	Weisse I. 335	9	20 27	9 43
29	Mars		1 17 58	3 7 37
	Weisse I. 335	9	20 27	9 43
30	Mars		1 18 6	3 8 12
	Weisse I. 335	9	20 27	9 43
31	Mars		1 18 12	3 8 22
	Weisse I. 335	9	20 27	9 43
Sept. 1	Mars		1 18 14	3 8 37
	Weisse I. 335	9	20 27	9 43
2	Mars		1 18 13	3 8 28
	Weisse I. 335	9	20 27	9 43

Date. 1862.	Object.	Mag.	α. h m s	δ. ° ′ ″
Sept. 3	Mars		1 18 9	3 8 5
	Weisse I. 335	9	20 27	9 43
4	Mars		1 18 2	3 7 27
	Weisse I. 335	9	20 27	9 43
5	Mars		1 17 51	3 6 36
	Weisse I. 330	8.9	20 9	5 26
6	Mars		1 17 37	3 5 30
	Weisse I. 330	8.9	20 9	5 26
7	Mars		1 17 19	3 4 12
	Weisse I. 330	8.9	20 9	5 26
8	Mars		1 16 58	3 2 39
	Weisse I. 330	8.9	20 9	5 26
9	* 1	9	1 15 37	3 3 55
	Mars		16 35	0 54
10	* 2	9.10	1 12 38	2 58 47
	Mars		16 7	58 55
11	* 2	9.10	1 12 38	2 58 47
	Mars		15 37	56 45
12	* 2	9.10	1 12 38	2 58 47
	Mars		15 4	54 22
13	* 3	9.10	1 12 28	2 49 50
	Mars		14 27	51 48
14	Mars		1 13 48	2 49 2
	Weisse I. 229	9	15 11	47 49
15	Mars		1 13 5	2 46 6
	Weisse I. 229	9	15 11	47 49
16	Mars		1 12 19	2 42 59
	Weisse I. 229	9	15 11	47 49
17	Mars		1 11 31	2 39 43
	B.A.C. 397	7.8	12 16	33 48
18	Mars		1 10 40	2 36 18
	B.A.C. 397	7.8	12 16	33 48
19	Mars		1 9 46	2 32 45
	B.A.C. 397	7.8	12 16	33 48

Date. 1862.	Object.	Mag	α. h m s	δ. ° ′ ″
Sept. 20	Mars		1 8 50	2 29 4
	B.A.C. 397	7.8	12 16	33 48
21	Mars		1 7 51	2 25 16
	* 4	9	10 17	22 36
22	Mars		1 6 51	2 21 23
	* 4	9	10 17	22 36
23	Weisse I. 20	9	1 3 7	2 15 40
	Mars		5 48	17 25
24	Weisse I. 20	9	1 3 7	2 15 40
	Mars		4 43	13 23
25	Mars		1 3 36	2 9 18
	* 5	9	6 5	11 50
26	* 6	9	1 2 4	2 2 20
	Mars		2 28	5 11
27	Mars		1 1 19	2 1 2
	* 6	9	2 4	2 20
28	Weisse 0·1031	9	0 59 0	1 53 35
	Mars		1 0 8	56 54
29	Mars		0 58 57	1 52 47
	Weisse 0·1031	9	59 0	53 35
30	Mars		0 57 44	1 48 41
	Weisse 0·1023	9	58 36	44 11
Oct. 1	Mars		0 56 31	1 44 39
	Weisse 0·1023	9	58 36	44 11
2	Mars		0 55 17	1 40 39
	Weisse 0·973	9	55 50	36 10
3	Mars		0 54 4	1 36 44
	Weisse 0·973	9	55 50	36 10
4	Mars		0 52 50	1 32 54
	Weisse 0·973	9	55 50	36 10
5	* 7	9	0 48 34	1 32 19
	Mars		51 36	29 10
6	Mars		0 50 23	1 25 34
	Weisse 0·871	8.9	50 36	20 46

Date. 1862.	Object.	Mag.	α. h m s	δ. ° ′ ″
Oct. 7	Mars		0 49 10	1 22 5
	Weisse 0·871	8.9	50 36	20 46
8	Mars		0 47 58	1 18 45
	Weisse 0·871	8.9	50 36	20 46
9	Mars		0 46 46	1 15 34
	* 8	9	49 38	17 0
10	Mars		0 45 36	1 12 33
	Weisse 0·806	9	46 34	9 38
11	Mars		0 44 26	1 9 42
	Weisse 0·806	9	46 34	9 38
12	Mars		0 43 18	1 7 3
	Weisse 0·806	9	46 34	9 38
13	Weisse 0·649	8	0 38 0	1 3 20
	Mars		42 11	4 35
14	Weisse 0·649	8	0 38 0	1 3 20
	Mars		41 6	2 10
15	Weisse 0·649	8	0 38 0	1 3 20
	Mars		40 3	0 19
16	Lalande 1123	9	0 35 35	0 56 24
	Mars		39 2	58 31
17	Lalande 1123	9	0 35 35	0 56 24
	Mars		38 2	56 57
18	Lalande 1123	9	0 35 35	0 56 24
	Mars		37 5	55 38
19	Lalande 1123	9	0 35 35	0 56 24
	Mars		36 10	54 35
20	Mars		0 35 17	0 53 47
	Lalande 1123	9	35 35	56 24
21	Mars		0 34 27	0 53 15
	Lalande 1123	9	35 35	56 24
22	Mars		0 33 40	0 52 59
	Lalande 1123	9	35 35	56 24
23	Mars		0 32 55	0 52 59
	Lalande 1123	9	35 35	56 24

Date. 1862.	Object.	Mag.	α. h m s	δ. ° ′ ″
Oct. 24	Mars		0 32 13	0 53 17
	Lalande 1123	9	35 35	56 24
25	Mars		0 31 34	0 53 51
	Lalande 1123	9	35 35	56 24
26	Mars		0 30 57	0 54 43
	Lalande 1123	9	35 35	56 24
27	Mars		0 30 24	0 55 51
	Lalande 1097	8.9	34 30	59 34
28	Mars		0 29 53	0 57 17
	Lalande 1097	8.9	34 30	59 34
29	Mars		0 29 26	0 58 59
	Lalande 1097	8.9	34 30	59 34
30	Mars		0 29 2	1 0 59
	* 9	9	29 40	5 34
31	Mars		0 28 40	1 3 15
	* 9	9	29 40	5 34
Nov. 1	Mars		0 28 22	1 5 48
	* 9	9	29 40	5 34
2	Mars		0 28 7	1 8 38
	* 9	9	29 40	5 34
3	* 10	9.10	0 27 44	1 10 0
	Mars		27 54	11 44
4	* 11	9.10	0 26 52	1 16 40
	Mars		27 45	15 6
5	Weisse 0·393	9	0 24 21	1 22 28
	Mars		27 39	18 44
6	Weisse 0·393	9	0 24 21	1 22 28
	Mars		27 36	22 38
7	Weisse 0·420	9	0 25 34	1 23 53
	Mars		27 36	26 47

U.S. Naval Observatory,
March 1862.

On the Minor Planet Feronia (71).* By Dr. C. H. F. Peters.

The observations made at the Hamilton College Observatory upon *Maja*, as it was supposed (see Brünnow's *Ast. Not.*, No. 27), from the 29th of May, belong, as Mr. Truman H. Safford has found, to another planet hitherto unknown. Having received, by the kindness of Professor Bond, the places of the comparison-stars from the *Harvard Zones*, not yet printed, I have been enabled to complete the reduction of the eight positions obtained between the 29th of May and 13th of June, and I have computed the following orbit for the new planet:—

Epoch, 1861, Jan. 0·0 Washington M.T.

M_0	211 50 4·27	
π	317 39 5·63	Mean Equinox of Epoch.
Ω	207 56 24·36	
i	5 21 58·33	
φ	7 0 15·84	
μ	1086″·924	
Log a	0·3425384	

The semi-axis major appears to be the smallest known of the asteroids, even a little smaller than that of *Flora;* which relation, however, of course is liable to be changed by further observations. The elements were derived from May 30, June 7, and June 13, with regard to the smaller corrections, and represent the whole series as follows:—

	Observed R.A.	C—O.	Observed Decl.	C—O.
	° ′ ″	″	° ′ ″	″
May 29	176 39 11·5	+3·2	+0 36 12·8	+2·2
30	176 47 34·2	+0·1	35 8·3	+0·3
31	176 56 15·6	−2·8	33 50·4	+1·4
June 1	177 5 18·6	−3·4	32 22·2	+1·6
7	178 6 27·6	+0·3	20 0·2	+0·5
8	178 17 41·4	−3·2	17 25·2	−0·9
10	178 41 14·6	+1·2	11 39·6	−1·7
13	179 18 35·1	0·0	+0 1 54·7	−0·1

The remaining errors are perhaps not larger than may be expected of observations by the ring-micrometer, and upon an object of about 13th magnitude; part of the differences, besides, may be owing to the star-positions. On May 31 and June 1, for example, the same comparison-star was used. The observation on May 29 is not very good; only few comparisons could be obtained.

* See p. 170, where the Planet is called (72). *Feronia* being (71), *Niobe* will be (72).—Ed.

In opposition the planet will appear of about the 11th magnitude; and there will be, therefore, no difficulty to find it again on or before the next one, which will happen in September.

At my request Mr. Safford has selected the name; and the number ought to be (71), in accordance with the date of the first observation.

In the *Comptes Rendus* (6 Jan., 1862) there is contained an article by M. Leverrier, "On the System of the Planets *Mercury*, *Venus*, the *Earth*, and *Mars*," giving a survey of his researches, as consisting of the three distinct parts, a new examination of the theories, a new discussion of the observations, and lastly, the comparison of the theories and observations. The provisionally assumed masses were

$$\text{Mercury} \quad m = \frac{1+\nu}{3000000}$$

$$\text{Venus} \quad m' = \frac{1+\nu'}{401847}$$

$$\text{The Earth} \quad m'' = \frac{1+\nu''}{354936}$$

$$\text{Mars} \quad m''' = \frac{1+\nu'''}{2680337}$$

ν, ν', ν'', ν''' being quantities to be determined.

But to make the results of the theory agree with the observations it would be necessary to attribute to these quantities values which are altogether inadmissible. For instance, the discussion of the secular variation of the perihelion of *Mercury* leads to the equation $87''\,\nu'' = +\,45'',5$, or the mass of the Earth would require to be increased by nearly one-half its value, and it thus becomes necessary to explain the greater part of the excess of the observed motion of the perihelion of *Mercury* by some extraneous action.

The serious difficulties which present themselves in the motion of the four planets, reduce themselves to the three principal ones; 1°, the excess of the motion of the perihelion of *Mars;* 2°, the excess of the motion of the node of *Venus;* 3°, the excess of the motion of the perihelion of *Mercury.*

The first two difficulties appear to arise from the same cause, the one and the other would be removed by an increase in the mass of the Earth, and this would indicate a perturbing cause placed between the two planets *Venus* and *Mars.* But, M. Leverrier asks, does it follow that the mass of the Earth must really be augmented, or may not the disturbing mass (the action of which should be about equal to a tenth

part of the mass of the Earth) be detached from the Earth, and in this case in what manner is it distributed ?

Among the objections, which seem not to permit the necessary addition to be made to the mass of the Earth, is the following; viz., an increase of one-tenth part in the mass of the Earth would disturb the relation that exists between the force of gravity at the surface of the Earth, the mass of the Earth, and the solar parallax, unless the solar parallax were increased by one thirtieth part.

The difficulties disappear by admitting that the perturbing mass is distributed among a considerable number of asteroids, such as exist between *Mars* and *Jupiter*, and whereof only the largest, it is probable, are observed; or such as observation shows to exist at a distance sensible equal to that of the Earth. Such a system of corpuscules would act especially on the perihelion of a planet having a considerable excentricity, and would give it a direct motion; it would less affect, or would not affect at all, the excentricity. It would be therefore, in the motion of the perihelion, attributed exclusively to the terms in the formulæ not depending on the longitude of this element, that a result can be obtained as to the total mass of these corpuscules.

But there is no means of deciding how much of the action is to be attributed to the group at the same distance as the Earth, and how much to the group between *Mars* and *Jupiter*. All that can be done is to assign superior limits to the masses of these groups respectively, by attributing to each of them successively the whole excess in the motion of the perihelion of *Mars*.

Assuming that the perihelia of the disturbing masses are uniformly distributed as to longitude, the results are,—

1°. If the whole excess in the motion of the perihelion of *Mars* is attributed to a ring of asteroids situate at a distance from the Sun equal to that of the Earth, the total mass of these asteroids will be somewhat greater than that of *Mars*, and will be equal to the fraction 0·138 of the mass of the Earth.

2°. If the whole excess is attributed to a group of asteroids between *Mars* and *Jupiter* (distance from the Sun between 2·20 and 3·16) the total mass of the group will be about one third of that of the Earth.

It is now, M. Leverrier thinks, established (*il reste acquis*) that it is not possible to represent all the observations of the system of the four inferior planets, by taking account only of their mutual actions and that of the Sun. But, at least, the difficulties are recognised and circumscribed in such manner that their solution cannot but be obtained, since astronomers now know the direction in which their efforts are to be made. On the one hand, the excess of the motion of the perihelion of *Mercury* is to be accounted for; and if the change of the

obliquity of the equator, deduced from the observations, be accepted, it is necessary to have recourse to the action of an extraneous and hitherto unknown cause. On the other hand, the analogous excess in the motion of the perihelion of *Mars* is to be accounted for; and, if the value of the solar parallax, deduced from the transits of *Venus*, be accepted, recourse must again be had to the action of an extraneous cause.

Disregarding the exceptional facts, and preserving the solar parallax $8''{\cdot}58$, the masses are definitively found to be,

$$\text{Mercury} \quad m = \frac{1}{4348000}$$

$$\text{Venus} \quad m' = \frac{1}{412150}$$

$$\text{The Earth} \quad m'' = \frac{1}{354030}$$

$$\text{Mars} \quad m''' = \frac{1}{2968300}$$

which are the values adopted in M. Leverrier's tables.

Captain Shea continues to communicate to the Society his Observations of Solar Spots, now extending over a period of 15 years.

Mr. Samuel Sharpe, of Highbury Place, has presented to the Society a 10-inch Reflecting Circle, by Troughton, with its counterpoise stand.

RECENT PUBLICATIONS.

Astronomische Beobachtungen auf der Sternwarte zu Bonn. Von Dr. Fr. W. A. Argelander. Dritter Band, Bonner Sternverzeichniss, Erste Section. Bonn, 1859. Vierter Band, Bonner Sternverzeichniss, Zweite Section, Bonn, 1861.

The first section contains the approximate mean places of 110984 stars between the declinations 2° south and 20° north, for the beginning of the year 1855; the second section the approximate mean places of 105075 stars between 20° and 41° north declination for the same epoch, observed and calculated with the co-operation of Dr. E. Schönfeld and Dr. A. Kruger, by Dr. Argelander, Director of the Observatory.

An account of the progress of this great work of the Survey of the Northern Hemisphere, communicated by the direction of Dr. Argelander, has recently appeared in the *Monthly Notices*, see the December number, p. 57.

CONTENTS.

Page

Fellows elected 229

On a Re-discovery of the missing Lunar Crater, *Alhazen*, situated on the western border of the *Mare Crisium*, by Mr. Birt ... ... ib.

Note on a dark, circular Spot upon the Sun's Disk, with rapid motion, as observed by W. Lummis, Esq., of Manchester, 1862, March 20, by Mr. Hind 232

Considerations on the Solar Spots, by M. Eugene Jeanjaquet ... 233

On the Transit of *Mercury* of 12 Nov. 1861, observed at Hobart Town, by Mr. Abbott 235

Results of Meridional Observations of Small Planets; Occultation of a Star by the Moon; and Phenomena of *Jupiter's* Satellites; observed at the Royal Observatory, Greenwich, during the month of March, 1862 236

Observations of Encke's Comet, taken with the Equatoreal of the Liverpool Observatory, by Mr. Hartnup 238

On Lambert's Theorem for Elliptic Motion, by Mr. Cayley ... ... ib.

On the Missing Nebula in *Taurus*, on Comet II. 1861, and on Mountain Attractions, by M. Otto Struve 242

Appointment of M. Otto Struve to the Directorship of the Observatory of Pulkowa 248

Letter from Sir John Herschel to Mr. Hind, on the Disappearance of a Nebula in *Coma Berenices* ... ... ib.

Opposition of *Mars*, 1862, by Lieut. J. M. Gilliss 250

On the Minor Planet *Feronia* (71), by Dr. Peters 256

On the System of the Planets *Mercury*, *Venus*, the *Earth*, and *Mars*, by M. Leverrier (from the *Comptes Rendus*) 257

Recent Publication:—

Astronomische Beobachtungen auf der Sternwarte zu Bonn, vols. iii. and iv., by Dr. Argelander 259

Printed by Strangeways and Walden, Castle St. Leicester Sq. and Published at the Apartments of the Society, May 10, 1862.